illuminates the ground on one side of the aircraft, using a fixed, small, wide-angle antenna. The synthetic aperture equals the distance flown during the observation time of about 0.2 second. Since the aperture is aligned with the flightpath, the conventional SAR is looking sideways at 90 degrees. The SAR technique has been extended for looking "almost forward"; it now illuminates the angular sectors of 5–45 degrees on both sides of the aircraft flight direction. Thus, the azimuthal resolution becomes a variable that depends on the look direction—it is zero looking straight forward, and improves with the squinting angle.

A conventional SAR, as well as the modified one, images stationary reflectors in their correct azimuthal location (range and elevation are always correct), whereas moving targets appear shifted in azimuth in proportion to their ground speed. This phenomenon is apparent in an SAR image of a moving train, where the train appears to run off the tracks. Incorporating a technique called "monopulse" alleviated this problem for *detecting* low-speed targets—although not for their accurate azimuthal *mapping*. The second figure shows the image of a two-dimensional uniform array of point-size reflectors on the ground on the right side of the flightpath (flying left to right). The smearing shows how the resolution degrades as the look angle approaches the flight direction.

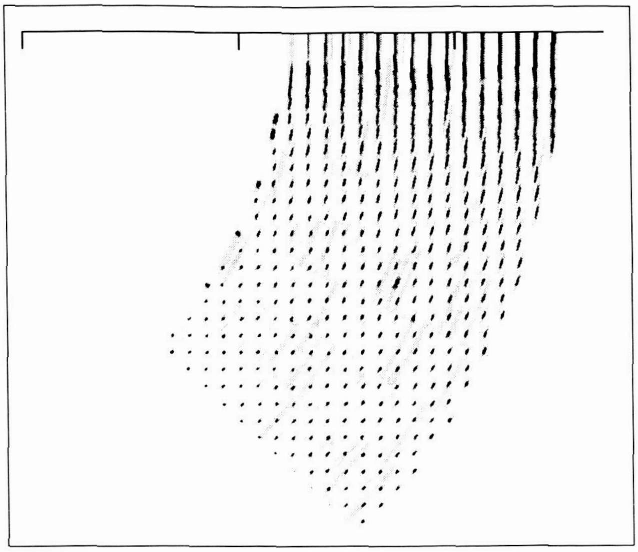

Fig. 2. Azimuthal resolution depends on squint angle.

Contact: Yair Barniv
(650) 604-5451
ybarniv@mail.arc.nasa.gov

Detection of Aircraft in Video Images

Jeffrey W. McCandless, Albert J. Ahumada, Mary K. Kaiser

NASA is collaborating with the aircraft industry to develop technology for a supersonic passenger airplane called the High-Speed Civil Transport (HSCT). One issue that is being examined is the replacement of the conventional forward cockpit windows with synthetic displays. The imagery in these displays would be obtained from video cameras mounted outside the aircraft. A benefit of this configuration is that the video imagery can be examined with computers to determine if another aircraft is in the scene. The goal of this HSCT subproject is to develop computer vision programs to detect aircraft that are moving in the video images.

During FY97, a series of computer programs were written to process video images and to search for moving objects (e.g., other aircraft). Flight tests were conducted in April and May to obtain the video imagery to test the computer programs. Each flight test was conducted with two aircraft. One aircraft was a Boeing 737 with a camera mounted below the nose. With a field-of-view of 13 degrees, this camera recorded the images of a second aircraft (the target plane) flying in various trajectories. For example, one trajectory consisted of the target plane flying from

Fig. 1. Video image showing another aircraft flying in the field of view of the camera mounted on the Boeing 737.

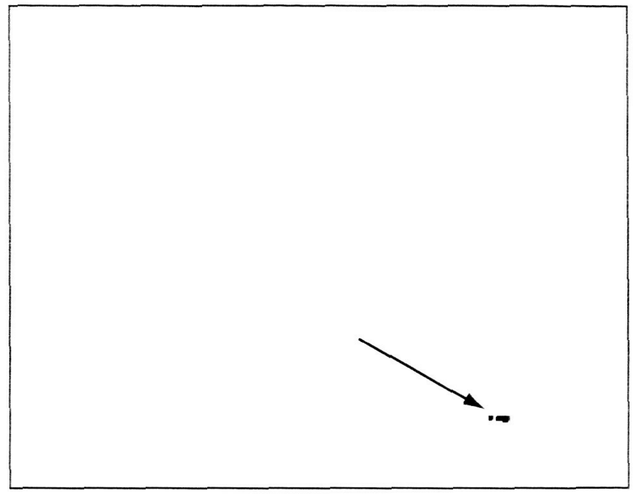

Fig. 2. Results of the computer program. The black region indicates the position of the aircraft in figure 1.

right to left across the path of the Boeing 737, producing the image in the first figure. The position of the target plane is indicated by the arrow in the figure. In this instance, the target plane was a Beech King Air 200 flying at a distance of 1 nautical mile from the Boeing 737. At this distance, it appears relatively small in the image. A computer program based on an optical flow algorithm located the aircraft, as shown in the second figure. In this latter figure, the area corresponding to the aircraft is shown in black.

Point of Contact: J. McCandless
(650) 604-1162
jmccandless@mail.arc.nasa.gov

Surface Operations Research and Evaluation Vehicle

Mary K. Kaiser

The new research vehicle sited at Moses Lake Airport in central Washington doesn't look like it has much in common with the conceptual drawings for the next-generation supersonic airliner, the High-Speed Civil Transport (HSCT). In fact, the Surface Operations Research and Evaluation Vehicle (SOREV) bears more passing resemblance to the large, wheeled irrigators used in the wheat fields surrounding the airport than it does to the sleek, delta-winged HSCT that will one day fly the Pacific Rim at over twice the speed of sound. Yet to researchers addressing issues associated with HSCT taxi operations, the SOREV is a thing of beauty.

The SOREV (shown in the figure) accurately captures the gear and flight-deck geometry of the full-scale HSCT. On the HSCT, there will be an unusually large distance between the flight deck and the nose gear (the pilot sits over 50 feet in front of the gear), and the SOREV provides test capabilities not available in existing test vehicles. Further, the SOREV permits researchers to investigate a number of issues and options associated with the development of an eXternal Visibility System (XVS), which replaces conventional forward-facing windows with synthetic displays. Like the HSCT, the SOREV is equipped with